TECHNICAL NOTES

Western Wheatgrass Germination as Related to Temperature, Light, and Moisture Stress

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Highlight: *Germination of western wheatgrass was best when seeds were held for 16 hr at temperatures between 55 and 75 F and 8 hr at temperatures between 75 and 90 F daily. Germination was independent of light but was severely reduced by moisture stresses above 1.0 atm.*

Natural regeneration of native perennial grasses in the badly depleted Rio Puerco watershed of west-central New Mexico is limited. The ecology of several grasses is being studied in an effort to determine which species are adapted to the area; the ultimate aim of these studies is to find one or more species which can be used to promote soil stabilization. Western wheatgrass (*Agropyron smithii* Rydb.) was chosen for study because (1) it is a rhizomatous, long-lived perennial and thus has a high soil-stabilizing potential, (2) it is adapted to alkaline soils such as those found in the Rio Puerco area, and (3) its seedlings are vigorous and develop rapidly.

The objective of the study reported here was to determine the optimum temperature and light requirements and the effects of moisture stress on germination of western wheatgrass. These findings will be used as guides for growing western wheatgrass seedlings in asphalt bands for adaptation-trial transplantings in the Rio Puerco watershed area.

Methods and Materials

Seeds used in the study were obtained from the New Mexico Plant Materials Center (Accession No. C-30). The seeds used were selected without regard to size or color, but were fully developed and undamaged. The seeds were germinated in 4-inch-diameter petri dishes on two thicknesses of standard blue germination blotter paper moistened with 18 ml distilled water, or the appropriate mannitol solution in the case of the moisture stress studies. Each treatment consisted of four replications of 100 seeds each held for 30 days at the appropriate temperature in growth chambers. Levels of moisture stress were attained with aqueous mannitol solutions prepared in accordance with the formula given by Helmerick and Pfeifer (1954); distilled water was used for the 0 atm tension treatment. Seedlings were counted daily from the second through the tenth day and at 3-day intervals thereafter. Seeds that produced seedlings with radicles and plumules 5 mm in length were counted as germinated. Molded and soft seeds were removed from the dishes as they occurred. The final germination percentages were transformed by arc sin square root of percentages prior to statistical analysis.

The optimum temperature for germination of western wheatgrass was determined by germinating the seeds in growth chambers programmed for 8 hr light and 16 hr darkness daily at constant temperatures of 50, 60, 70, 80, 90, and 100 and at alternating temperatures of 55-75, 60-80, 65-85, 70-90, 75-95, and 80-100 F. Under alternating temperature regimes, the growth chambers were programed for 8 hr at the high temperature with light and 16 hr at the low temperature in darkness.

Germination under moisture stress was tested at all the alternating temperatures except 80-100 F. Germination in total darkness was tested at alternating temperatures of 60-80 and 65-85 F.

Results and Discussion

Temperature Effects

Germination of western wheatgrass not subjected to moisture stress was best and equally good at alternating temperatures of 55-75, 60-80, 65-85, 70-90, and 75-95 F (Table 1). Germination at all of these temperatures, except 75-95 F, was better than at any of the constant temperatures. There was a progressive trend toward reduced germination from 60-80 to 75-95 F, and germination at 80-100 F was significantly less than at all other alternating temperatures as well as at constant temperatures above 60 F. Germination was significantly less at constant temperatures of 70 and above than at 50 and 60 F.

Table 1. Percent germination of western wheatgrass as related to temperature (°F) and light.

Temperature[1]	8 hr light daily	No light
50	[2]68b	
60	70b	
70	57c	
80	26	
90	11	
100	0	
55- 75	81a	
60- 80	82a	81
65- 85	81a	82
70- 90	76a	
75- 95	71ab	
80-100	57c	

[1]Seeds germinated at constant temperatures received 8 hr light daily; alternating temperature regimes consisted of 16 hr daily at the low temperature in darkness and 8 hr daily at the high temperature in light.

[2]Any two values not followed by the same letter are significantly different (.05 level, Duncan multiple range procedure).

Germination at all alternating temperatures, even 80-100 F, was significantly better than at the three highest constant temperatures, 80, 90, and 100 F. Why high alternating temperatures resulted in better germination than high constant temperatures was not revealed: this phenomenon is probably due to the fact that under alternating temperature regimes the seeds are subjected to longer periods daily (16 hr) at the lower and more favorable temperatures.

Light Effects

Germination of western wheatgrass was independent of light; percent germination of seeds exposed to light for 8 hr daily and those held in complete darkness did not vary more than 2 percent (Table 1).

Moisture Stress Effects

The overall differences among both temperature and levels of moisture stress were highly significant; temperature–levels of moisture stress interaction was also highly significant. Increases in moisture stress caused a strong linear downward trend in percent germination (Fig. 1). The same was essentially true with respect to temperature departure

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from the optimum, 60-80 F (Fig. 1). There was, however, a significant temperature–level of moisture stress interaction.

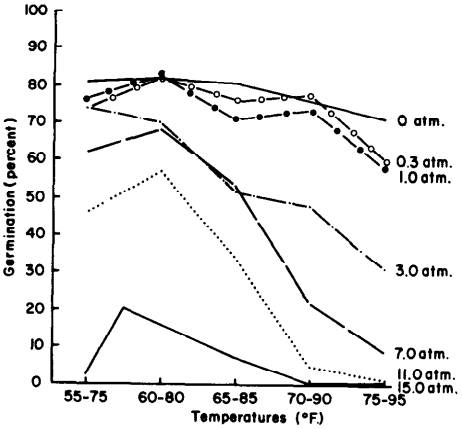

Fig. 1. *Temperature-moisture stress interrelations in germination of western wheatgrass.*

Conclusions

Western wheatgrass is a cool-season germinator; maximum germination can be expected only during seasons when daily maximum soil temperatures do not exceed 90 F and when nighttime minimum soil temperatures are 75 F or below.

Germination of western wheatgrass was significantly reduced by stresses greater than 1.0 atm. The detrimental effect of moisture stress was increasingly severe with increasing temperature above optimum.

Germination of western wheatgrass is independent of light.

Literature Cited

Helmerick, R. H., and R. P. Pfeifer. 1954. Differential response of winter wheat germination and early growth to controlled limited moisture conditions. Agron. J. 46:560-562.

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